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Sleep Hygiene Program for Night Shift Workers

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Sleep Hygiene Program for Night Shift Workers

by

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Abstract

Sleep is vital to health and wellbeing. Service professionals such as nurses, firefighters, and police officers, historically have worked in shifts requiring around the clock coverage. Now, many companies are following similar strategies with working employees in 12 hour or 8 hour shifts including night shift. Night shift workers must adjust to sleeping during the daytime by combating their normal circadian regulatory system. Maladaptation to daytime sleep can affect overall sleep time and poorer sleep quality. Shift Work Disorder is a medical condition where employees struggle with chronic sleep deprivation that can lead to other health problems. Employee health clinics offer an excellent resource to implement evidence-based strategies to assist night shift employees with methods to improve daytime sleep.

Keywords: sleep deprivation, shift work disorder, blue-light therapy, sleep-hygiene

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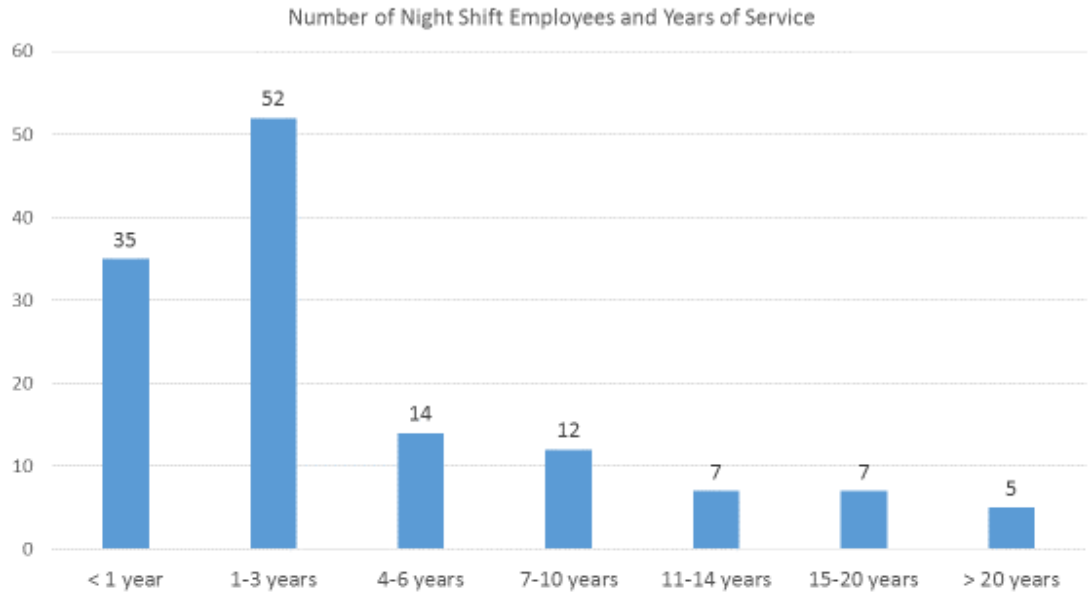
Background

Sleep is as essential as food and water. Humans spend about a third of their lives asleep (Karagozoglu & Bingol, 2008). According to Healthy People 2020 (2015), sleep is a critical determinant of health and well-being. Adequate sleep supports immunity, blood sugar metabolism, work performance, and work safety (Healthy People 2020, 2015). Man's basic physical activities begin with the first hour of the day and decreases towards night (Karagozoglu & Bingol, 2008). The circadian rhythm is man's 24 hour night and day (sleep and awake) regulatory system or man's biological clock (Karagozoglu & Bingol, 2008). One of the main functions of the circadian rhythm is preparing the body for sleep (Karagozoglu & Bingol, 2008). Over the last 30 years, there has been a significant increase in the number of individuals sleeping less than six hours in a 24-hour period (Healthy People 2020, 2015). These individuals have been categorized as "short sleepers" (Healthy People 2020, 2015). An example of this is demonstrated in a recent study looking specifically at the sleep habits of nurses working 12 hour shifts. The results showed that both day and night 12 hour shift nurses slept less than six hours when working consecutive shifts (Geiger-Brown et al., 2012). The average total sleep time (TST) after the first 12 hour shift was 5.7 hours for nurses working on the day shift and was 5.2 hours for nurses working on the night shift (Geiger-Brown et al., 2012). On average, intershift sleep was two hours shorter than the day prior to the first shift (Geiger-Brown et al., 2012). After the third consecutive 12 hour shift, the TST averaged 7.3 hours for nurses working on the day shift and 5.1 hours for nurses working on the night shift (Geiger-Brown et al., 2012). It has been illustrated through research that night shift

workers sleep an estimated 10 hours less per week than those working evening or dayshift (Akerstedt, 2003).

Problem Recognition

In observing employees of a manufacturing company in the western portion of a mid-Atlantic state, sleep deprivation and sleep quality appeared to be a concern with individuals working night shift. When interviewing employees, the vast majority felt they did not get enough sleep and felt chronically fatigued. Many of these employees verbalized that they have some displeasure for their job because of inadequate sleep. The bulk of the employees interviewed slept six hours or less, citing difficulties with getting to sleep and staying asleep as the main reasons for their sleep deprivation. In discussing the problem with the Human Resource department, the majority of job turnover was with the night shift employees. Most employees on night shift had been working with the company for less than three years (see Figure 1.). As of 2014, night shift employee retention appeared to be low possibly related to sleep deprivation resulting in job dissatisfaction. Also in 2014, there were 60 recordable accidents, 45 of the accidents were on night shift.



Note. As of 2014, the majority of night shift employees had worked less than 3 years. Temporary Employees were not known and not listed in graph.

Figure 1. Number of Night Shift Employees and Years of Service.

Needs Assessment

Information gained from interviews with night shift employees indicated that lack of sleep was a factor in job satisfaction. Human Resource records demonstrated that the majority of night shift workers have been employed less than three years (see Figure 1.). Sleep deprivation resulting in poor job satisfaction could be a contributing factor to job turnover on night shift. Performing a needs assessment was deemed to be necessary.

Sleep disorders affect day and night shift workers. Shift Work Disorder is a condition were employees have difficulty with daytime sleep and exhibit excessive sleepiness secondary to working night shift. In performing the needs assessment, the following questionnaires were handed out to night shift workers at the July, 2015

quarterly employee meetings to identify common causes for sleep deprivation. The questionnaire had two sections. The first three questions were used to assess for symptoms of Shift Work Disorder.

- Do you experience difficulties with sleeping or excessive sleepiness? (yes/no)
- Is the sleep or sleepiness problem related to a work schedule where you have to work when you normally sleep? (yes/no)
- Has this sleep or sleepiness problem related to your work schedule persisted for a least at least one month? (yes/no)

These questions follow the International Classification of Sleep Disorders (ICSD-2) for diagnosing Shift Work Disorder (Waage et al., 2009). For the first set of questions, if the employee answered yes to all questions, the employee scored a "yes" for symptoms of Shift Work Disorder. The second set of questions used the Global Sleep Assessment Questionnaire (GSAQ) to help screen for Shift Work Disorder and various other sleep disorder symptoms that might affect night shift workers (Roth et al., 2002). For the GSQA, if the employee answered "usually" or "always" then the employee scored a "yes" for that particular sleep disorder. The answers of "never" or "sometimes" were scored as a "no". The following GSAQ questions made up the second section of questions.

- Did you have difficulty falling asleep, staying asleep, or feeling poorly rested in the morning? (never, sometimes, usually, always)
- Did you fall asleep unintentionally or have to fight to stay awake during the day? (never, sometimes, usually, always)

- Did sleep difficulties or daytime sleepiness interfere with your daily activities? (never, sometimes, usually, always)
- Did work or other activities prevent you from getting enough sleep? (never, sometimes, usually, always)
- Did you snore loudly? (never, sometimes, usually, always)
- Did you hold your breath, have breathing pauses, or stop breathing in your sleep? (never, sometimes, usually, always)
- Did you have restless or "crawling" feelings in your legs at night that went away if you moved your legs? (never, sometimes, usually, always)
- Did you have repeated rhythmic leg jerks or leg twitches during your sleep? (never, sometimes, usually, always)
- Did you have nightmares, or did you scream, walk, punch, or kick in your sleep? (never, sometimes, usually, always)
- Did the following things disturb your sleep: pain, other physical problems, worries, medications, or other? (never, sometimes, usually, always)
- Did you feel sad or anxious? (never, sometimes, usually, always)

Permissions were obtained from the author(s) to use the above three questions (S. Waage, personal communication, May 4, 2015) and the Global Sleep Assessment Questionnaire (T. Roth, personal communication, April 1, 2015). Table 1 below provides the results from the two section questionnaire used in the July 2015 night shift employee meeting.

Table 1

Results from the Two Section Questionnaire

Possible Sleep Disorder Causes	Prevalence in Night Shift Employees
Shift Work Disorder	39%
Sleep Apnea	20%
Worries	9%
Pain	8%
Restless Legs	6%
Other	4%
Other physical problems	4%
Periodic Limb Movement	4%
Anxiety	3%
Medications	2%
Parasomnias	1%

Note. Prevalence of sleep disorder causes from July 2015 night shift employee meeting.

The National Institute of Health recommends 7-8 hours of sleep daily. The final question on the July 2015 employee meeting questionnaire was to see how much sleep time night shift employees were receiving. Table 2 provides the results.

Table 2

Sleep Time Night Shift Employees Receive

	Less than 7 Hours Sleep	More than 7 Hours Sleep	Left Blank on Questionnaire
How many hours do you typically sleep after working night shift?	Total of 109 employees or 74% of night shift	Total of 33 employees or 23% of night shift	Total of 5 employees or 3% of night shift

Note. The results included full time and temporary night shift employees.

Population

The night shift at the project facility includes manufacturing employees working eight hour and 12 hour shifts. Respondents included 147 men and women of temporary and full-time status.

Stakeholders

The Manager of Health and Welfare Benefits was the chief stakeholder for any assessed problem with employee health. She also was the internal contact person to assist with any potential project coordination and/or implementation along with the associated costs. If the project deemed beneficial, the Manager of Health and Welfare

Benefits would report directly to the Vice President of Human Resources for additional approval. A sleep hygiene startup capstone project was approved to study sleep interventions to potentially improve sleep time and sleep quality for night shift workers.

SWOT Analysis

Strengths

The manufacturing company provides a culture of wellness for its employees. By providing on-site screenings (lab work, mammograms, acute care visits) and health promotion activities (health coaching, weight loss incentives), employees are provided a cost-effective and convenient way for improving their health. The employee clinics are available at opportune times by being open during day and night shift work hours. The employees are given access to a nurse practitioner for consultation on acute or chronic conditions. The facility had the resources to implement the project.

Weakness

The company's employee clinics did not have a sleep program in place for night shift workers.

Opportunities

In speaking with the company nurse, at the time of the project, there was not a policy on fatigue or sleep in regards to employee safety and machine operation. If the nightshift sleep project was deemed to be successful, a policy would be implemented to screen for sleep deprivation at each required annual wellness visit at employee clinic or at initial employee clinic visit for new hires on night shift.

Threats

Potential threats to project that were considered were the cooperation of employees to be compliant with sleep project interventions. Also, consideration was given that some employees may have attitudes and prejudices about expectations of night shift work and sleep which could affect the project (example: " a person is supposed to sleep less working nights").

Theoretical Framework

The Neuman Systems Model (NSM) was the conceptual model that was utilized as a guide for this project. The NSM has been widely used in nursing education and research. Simply, the NSM looks at the ideal client (patient) as a system that successfully adjusts to internal and external environmental stressors to maintain normal wellness stability. It is comprised of a core consisting of several variables: physiological, psychological, developmental, sociocultural, and spiritual. Concentric circles around the core (client system) provide varying levels of defense. The normal line of defense is the systems normal or usual wellness level (Fawcett & Desanto-Madeya, 2013). Expansion of the normal lines of defense reflects an enhanced wellness state; however, contraction of the normal lines of defense diminishes the state of wellness (Fawcett &Desanto-Madeya, 2013). The lines of resistance protect the basic structure and return the client to wellness at the same or a higher state of wellness (Fawcett & Desanto-Madeya, 2013). The lines of resistance protect the client system from system instability that could result from invasion of stressors (Fawcett & Desanto-Madeya, 2013). Stressors make up a client's environment. The stressors can be internal or external. The internal environment

represents the intrapersonal stressors. The external environment represents the interpersonal and extra personal stressors (Fawcett & Desanto-Madeya, 2013).

Secondary Prevention

Secondary prevention involves identifying an actual risk factor associated from an environmental stressor. With night shift workers, night shift would be an external environmental stressor and extra-personal, sociocultural stressor to the client system (night shift sleep program participant). The stressor's influence on the client's normal line of defense and lines of resistance is measured as sleep quality and total sleep time. Please see Figure 2 for project variables using Neuman Systems Model.

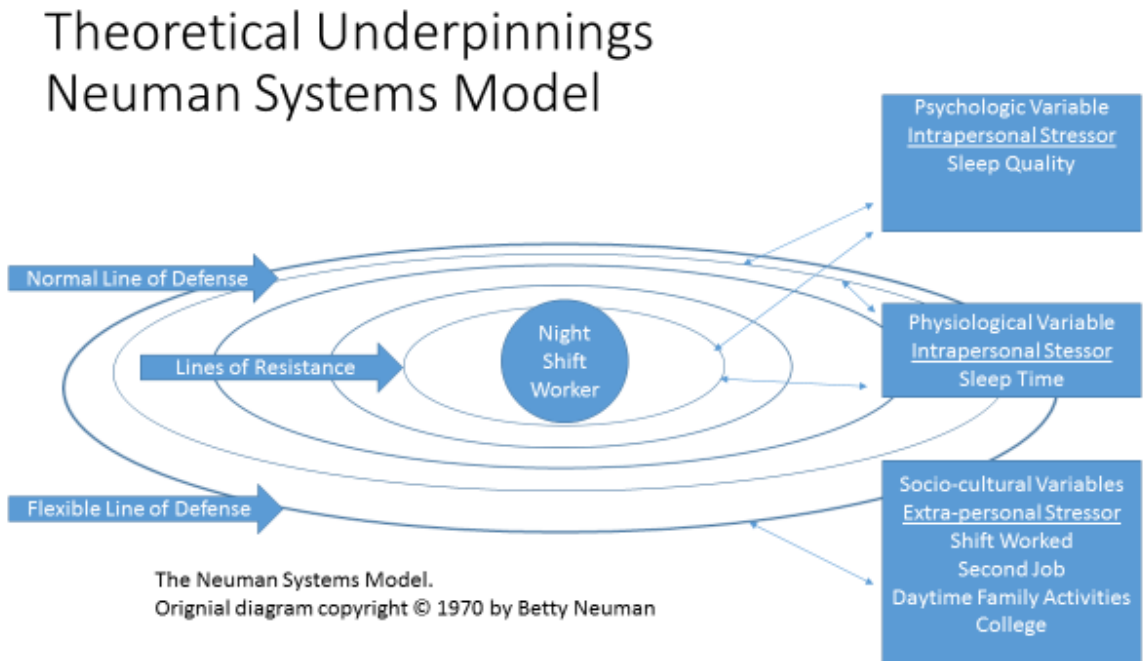


Figure 2. Project Variables using Neuman Systems Model.

Literature Review

Consequences of Sleep Deprivation

Employee health. As previously mentioned, adequate sleep is vital to the body. Chronic sleep deprivation has been linked to hypertension, heart disease, obesity, and diabetes (Healthy People 2020, 2015). In a recent study, the Harvard School of Medicine demonstrated that prolonged sleep restriction with concomitant circadian disruption slowed the metabolic rate and increased postprandial plasma glucose levels (Buxton et al., 2012). The researchers concluded that chronic sleep deprivation with a continual alteration in the normal circadian cycle could possibly increase the risk of a person developing obesity and diabetes (Buxton et al., 2012).

Job satisfaction. Job satisfaction is key to employee retention. In a study looking at job satisfaction of nurses, as sleep quality increased so did job satisfaction (Karagozoglu & Bingol, 2008). The researchers concluded that working night shift or rotating shifts had a negative effect on their sleep quality and thus less job satisfaction. Day shift nurses have the highest sleep quality and highest job satisfaction scores (Karagozoglu & Bingol, 2008). A separate study examined the relationship between shifts length and nurse burnout. It was demonstrated that increases in shift length were associated with increased odds of job dissatisfaction, burnout and intention to leave the job (Stimpfel, Sloane, & Aiken, 2012). Job dissatisfaction and burnout were highest when nurses worked longer than 13 hour shifts (Stimpfel et al., 2012). Employees working longer, consecutive night shifts can lead to sleep deprivation, job dissatisfaction, and burnout.

Employee Safety. A recent study evaluated the sleep habits of 3,345 New York State workers. Their total sleep time was 6.7 hours in length. Short sleepers (< 6 hrs) were mostly associated with night shift work (Ohayon, Smolensky, & Roth, 2010). Some 20% of employees demonstrated excessive sleepiness in jobs requiring high attention, and these individuals were strongly associated with working nights (Ohayon et al., 2010).

Sleep quality. "Sleep quality" can mean different things to different people. For some it can mean restlessness during the night, movement during sleep, anxiety, tension, or calmness when trying to sleep (Harvey, Stinson, Whitaker, Moskovitz, & Virk, 2008). For others, it can mean ease of sleep onset, sleep maintenance, total sleep time, and early awakening (Harvey et al., 2008). It has been well established that night shift works against the bodies' normal circadian rhythm. Night workers are required to be active when their body rhythms are preparing for inactivity and sleep, and sleep when their bodily rhythms are preparing them to be active and awake (Waage et al., 2009). A study of night shift Taiwan nurses demonstrated that the majority of studied night shift workers (57%) demonstrated poor sleep quality and overall reduction in quality of life measures (Shao, Chou, Yeh, & Tzeng, 2010). In a similar study of night shift oil rig workers, the prevalence of poor sleep quality and subjective health complaints were demonstrated more often in individuals with Shift Work Disorder than night shift workers without this disorder (Waage et al., 2009). A separate study looking at sleep quality found that night shift workers were 4.8 times more likely to have difficulty with sleep onset and that night shift workers were more likely to have chronic sleepiness and insomnia (Walia, Hayes, Przepyszny, Karumanchi, & Patel, 2012). The study also concluded that individuals indicating sleep problems related to shiftwork were less likely to be referred to a sleep

medicine specialist for effective treatment options (Walia et al., 2012). The following headings will further discuss Shift Work Disorder and how an employee clinic night shift sleep hygiene program may help with identifying this sleep disorder along with nonprescription interventions to help manage it.

Shift Work Disorder

It has been estimated that 20% of the workforce in industrialized countries are night shift workers (Sateia, 2014). The literature review demonstrates that many of these night shift workers have poor sleep quality. Shift Work Disorder is a medical condition where individuals display repeated insomnia and/or excessive sleepiness, along with a decrease in TST. The following table will provide the most recent criteria for identifying Shift Work Disorder. (Table 3)

Table 3

International Classification of Sleep Disorders (ICSD-3)

A. There is a report of insomnia and/or excessive sleepiness, accompanied by a reduction of total sleep time, which is associated with a recurring work schedule that overlaps the usual time for sleep.
B. The symptoms have been present and associated with the shiftwork schedule for at least three months.
C. Sleep log and actigraphy monitoring (whenever possible) for at least 14 days (work and free days) demonstrate a disturbed sleep and wake pattern.
D. The sleep and/or wake disturbance are not better explained by another current sleep disorder, medical or neurological disorder, mental disorder, medication use, poor hygiene, or substance use disorder.

Note. Criteria A-D must be met for diagnosis of Shift Work Disorder.

Essential Features of Shift Work Disorder

Shift Work Disorder is characterized by excessive sleepiness or chronic insomnia due to a work schedule of being awake when one is typically sleeping (Sateia, 2014). TST is typically curtailed by 1 to 4 hours and sleep quality is perceived as unsatisfactory (Sateia, 2014). It is estimated that between 10% and 38% of night shift workers exhibit signs of Shift Work Disorder (Sateia, 2014).

Influencing and Precipitating Factors of Shift Work Disorder

Individuals adjust to night shift work by circadian preference. "Morning type" individuals may have a more difficult time sleeping during the day. Whereas, "night owls" may prefer staying up late and sleeping during the day. Also, persons with comorbid medical, psychiatric, and other sleep disorders (sleep apnea) may be at particular risk for working night shift (Sateia, 2014). Many individuals who work nights feel they have social pressures to stay awake during the day. This may include family obligations, a second job, school, or leisure activities (Sateia, 2014). All of these circumstances can reduce the likeliness of circadian adjustment and can deplete much-needed sleep.

Onset and Complications of Shift Work Disorder

When employees are hired for night shift, coupled with working an extended shift, fatigue can result. Circadian adaptation many times is offset by exposure to light at the wrong time of the day (Sateia, 2014). With this exposure to light, there can be a tendency to resume daytime activities which further diminishes needed restorative sleep time. This chronic sleep deprivation and circadian misalignment may lead to problems

with fatigue and excessive sleepiness and can predispose individuals to safety concerns related to work or with driving a motor vehicle (Sateia, 2014).

Objective Findings of Shift Work Disorder

Shift Work Disorder can usually be diagnosed by history. Sleep logs and actigraphy are recommended to demonstrate the typical disruption on the sleep wake pattern in Shift Work Disorder (Sateia, 2014).

Sleep diary. Sleep diaries or logs are used to measure sleep habits in clinical research and practice (Redeker & McEnany, 2011). Sleep diaries provide estimates of sleep time, napping, and feelings of sleepiness. Information can also be gained on habits and activities that can negatively affect sleep, such as medications, stress, alcohol use, and caffeine use (Redeker & McEnany, 2011). The sleep log below was used in the sleep hygiene project to study the sleep habits of night shift workers. (Figure 3)

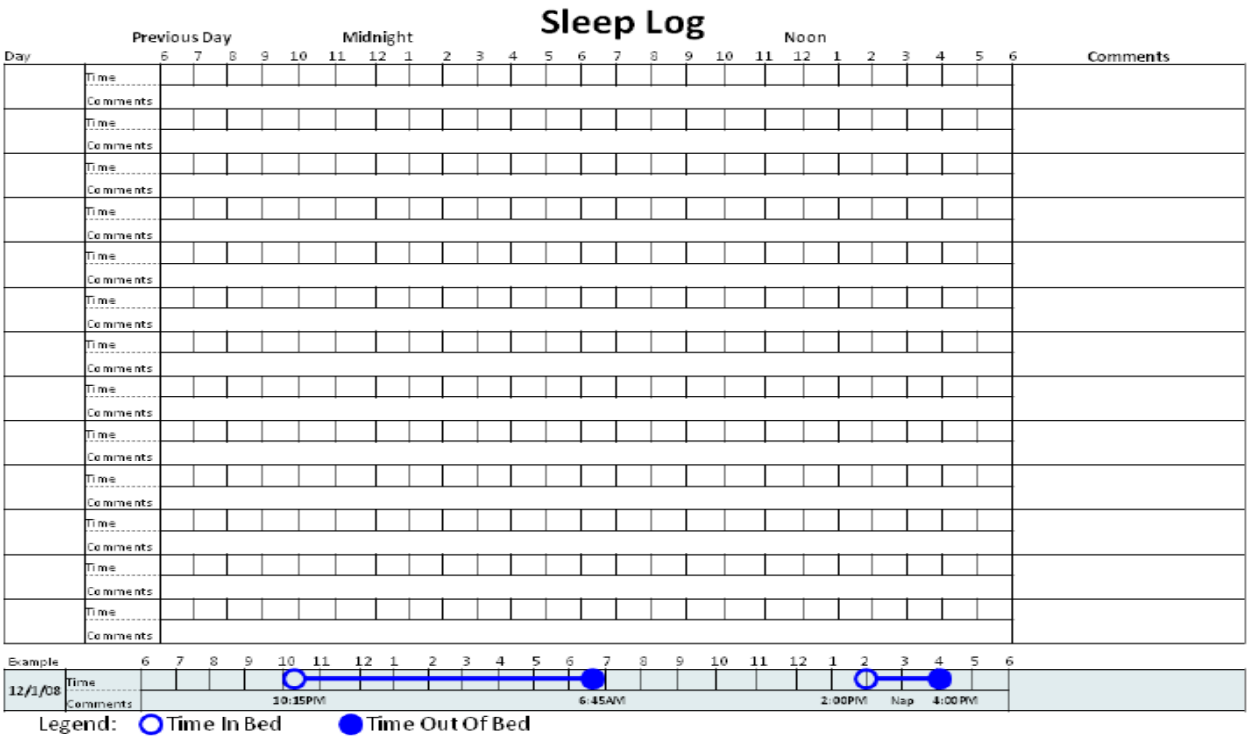


Figure 3. Source: ActiGraph Sleep Log.

Actigraphy. The actigraphy device is a widely used method for measuring sleep time (Redeker & McEnany, 2011). Actigraph are small wristwatch-like devices that measure the frequency of body movements. With Shift Work Disorder, the person wears the device for two weeks, and the device records sleep patterns. The device records movement when the person is awake and little to no movement when a person is asleep (Redeker & McEnany, 2011). Both the sleep diary and the Actigraph monitor would show a disturbed sleep pattern to assist in the diagnosis of Shift Work Disorder.

Goal of Project

The magnitude of acute or chronic sleep deprivation for workers has been well documented. Work injuries or accidents have been linked to workers who are sleep deprived. Chronic sleep deprivation has been shown to increase the risk of cardiovascular diseases such as hypertension, stroke and heart disease, as well as obesity and diabetes (Redeker & McEnany, 2011). Information from interviews with night shift employees and from questionnaires from the July 2015 night shift meeting indicated many night shift workers had the symptoms of Shift Work Disorder. This chronic sleepiness/fatigue could put individuals at risk for health problems, accidents, and job dissatisfaction. Based on the needs assessment, evidence-based solutions for shift work disorder were evaluated for effectiveness in starting a sleep hygiene program for night shift employees. Interventions included: sleep time shifting, light therapy at awakening from daytime sleep and during night shift, blue-light blocking sunglasses on the way home from work, melatonin 3 mg prior to daytime sleep and home environmental changes (darkening room, earplugs, turning off electronics, etc.). Sleep logs and Actigraph measurements were to be taken for two weeks for baseline information and

appropriateness for participation in project. The Pittsburgh Sleep Quality Index (PSQI) questionnaire was obtained to measure baseline sleep quality. After sleep program interventions were used for 3-4 weeks, employees would be reassessed using the PSQI questionnaire to see if sleep quality improved and actigraph wrist devices were to be downloaded and compared with sleep logs to see if sleep time had improved.

If deemed beneficial, policy implementation would be initiated to start a sleep hygiene program that would routinely screen all employees working night shift for problems with excessive sleepiness from poor sleep quality and decreased sleep time. Individuals demonstrating symptoms of poor sleep quality and decreased sleep time would then be assessed for appropriateness for the implementation of the various sleep hygiene interventions.

As previously stated, secondary prevention would be the goal for the initiation of a sleep hygiene program. Neuman Systems Model would be used as the conceptual framework for testing the sleep hygiene program interventions to see if there is an improvement in sleep quality and sleep time. Table 4 provides the CTE diagram illustrating Neuman Systems Conceptual Model and the internal and external environmental stressors that effect sleep time and sleep quality of the night shift worker.

Table 4

Neuman Systems Conceptual Model

Neuman Systems Conceptual Model	Client System	Normal Line of Defense and Lines of Resistance Psychological Variable	Normal Lines of Defense and Lines of Resistance Physiological Variable	Flexible Line of Defense Socio-Cultural Variables
Shift Work Effects on Quality of Sleep and Total Sleep Time	Employee	Sleep Quality <u>Intrapersonal Stressor</u>	Sleep Time <u>Intrapersonal Stressor</u>	Night Shift Day-Second Job Day-College Day –Family Events <u>Extra-personal Stressors</u>
Empirical Research Methods	Night Shift Worker	Pittsburgh Sleep Quality Index Questionnaire	Actigraph Sleep Logs Self-Reported	Self-Reported

Note. C-T-E Diagram

Project Design

Population

The project took place at a manufacturing company's employee clinics which were located in various counties located in the western portion of a mid-Atlantic state. The intervention group was made up of a randomized group of eight hour and 12 hour night shift workers demonstrating symptoms of shift work disorder. The night shift consisted of adult male and female employees. Night workers were predominately Caucasian but also consisted of African American, Asian, and Hispanic employees. Insured employees were routinely screened for chronic health conditions through labs and wellness visits at the employee clinic. As previously stated, sleep was not previously being addressed as a routine screening component.

Team Selection

The team members consisted of the Manager of Health and Welfare Benefits and the employee clinic Certified Nursing Assistant. The Manager of Health and Welfare Benefits helped coordinate a time for project questionnaires to be distributed at a routine quarterly night shift meeting. The Certified Nursing Assistant helped with data collection and adjustment in normal clinic schedule to accommodate the sleep project.

Best Practices Development

Sleep timing. Night shift workers usually revert back to dayshift sleep patterns on nights off. This can lead to their circadian systems becoming dysregulated, developing poorer sleep throughout the work schedule cycle (Redeker & McEnany, 2011). It has been shown that night shift workers adopt a compromised sleep circadian system towards night shift alertness, where individuals stay awake longer on days not

working (going to bed at 3 am) and sleeping later (arising at 11 am) (Redeker & McEnany, 2011). When finishing the shift, individuals should not spend time socializing, shopping or performing chores, but rather, should get home and go straight to bed before the circadian clock starts stimulating the body to wake up (Redeker & McEnany, 2011).

Time light exposure. Timed light exposure is a guideline in an individual demonstrating symptoms of Shift Work Disorder. Light exposure (2,350 to 12,000 lux) administered (at 20 minute breaks, at least 50% of the shift, during the first half of the shift, or as long as possible during the shift) during the night shift has demonstrated to improve work performance, alertness, and mood compared to ordinary light exposure. Some studies have demonstrated that nighttime light exposure can also improve daytime sleep (Morgenthaler et al., 2007).

Blue-light blocking sunglasses. Night shift workers wearing blue light-blocking sunglasses on the way home can diminish the circadian upswing from bright morning light (Sasseville, Benhaberou-Brun, Fontaine, Charon, & Hebert, 2009). Research has demonstrated that blue light-blocking sunglasses appear to improve daytime sleep in individuals working night shift. Sleep time has been shown to significantly improve with individuals wearing these type sunglasses on their way home from work until time they went to bed (Sasseville et al., 2009).

In a separate study, night shift performance was improved when individuals wore blue light-blocking sunglasses up until 4 pm on days off of work and also after leaving night shift until going to bed. The researchers believe that shifting the circadian clock would help to reduce the misalignment with daytime sleep and night work. From the

results, they concluded that this can be an effective countermeasure to improve alertness and performance with night shift workers (Smith & Eastman, 2008).

Environment for restorative sleep. The following Table 5 provides steps for creating an appropriate environment for restorative daytime sleep (Thorpy, 2010).

Table 5

An Appropriate Environment for Restorative Sleep

Steps:	Practical advice:
Ensure the room is dark if sleep is required during the daytime.	Ensure the room has sufficiently Install black-out blinds in all windows.
Ensure a constant temperature in bedroom.	Aim for temperature around 68° F Avoid too many bed clothes.
Reduce noise exposure before and during the required sleep period.	Avoid watching TV or listening to loud music before sleeping. Use a room at the rear of the house if near a busy road. Consider earplugs if the ambient noise is intrusive. Put telephones on an answering machine. Ask family members to be quiet.
Avoid large meals, caffeine containing drinks, smoking, and alcohol before the required sleep period.	Schedule mealtime so that the main meal of the day is during or before the work period. Consider having a warm, milky drink before the required sleep period.

Note. From Supplement to The Journal of Family Practice – Jan. 2010/Vol 59, No 1

Melatonin. Timed melatonin is indicated as a guideline for symptoms of shift work disorder. Compared to placebo, melatonin taken prior to daytime sleep after night shift work improves daytime sleep quality and duration (Morgenthaler et al., 2007). The doses of melatonin studied ranged from 0.5 mg to 10mg. Effectiveness did not appear to correlate with an increase in dose or change in form (Morgenthaler et al., 2007).

Timeline

Table 6

Timeline

	Task A	Task B
July	Provide and collect questionnaires at July night shift meeting.	
August 16th week	Interview potential project participants. Go over employee meeting questionnaire with employee.	Use Pittsburgh Sleep Quality Index (PSQI) questionnaire for baseline information on potential participants.
August 23rd week	Group 1 The first group will each be given actigraph wrist monitor and sleep diary.	
September 6th week		After 2 weeks – Computer Download Group 1 Actigraph Monitor to see if appropriate for project (sleeping < 6.5 hours).
September 6th week 13th week 20th week 27th week	Group 1 will continue to wear actigraph monitor and participants will be started on sleep project interventions. At the end of 28 days. PSQI questionnaire repeated.	
October 4th week	Group 2 in October, second group will be given actigraph wrist monitor and sleep diary.	
October 18th week		After 2 weeks – Computer Download Group 2 Actigraph Monitor to see if appropriate for project (sleeping < 6.5 hours).
October 18th week 25th week November 1st week 8th week	Group 2 will continue to wear actigraph monitor and participants will be started on sleep project interventions. At the end of 28 days. PSQI questionnaire repeated.	

Outcome Measurements

Actigraphy. According to the American Academy of Sleep Medicine (AASM), for individuals demonstrating symptoms of shift work disorder, sleep diaries, and actigraphy are considered guidelines for identifying and evaluating the response to therapy for individuals demonstrating symptoms of shift work disorder (Morgenthaler et.al, 2007). In the night shift sleep hygiene project, the Actigraph wrist monitor was to be used as a quantitative measure to demonstrate total sleep time for participating employees. The Actigraph portable device records limb movement over an extended period of time and has been extensively used in the study of sleep and circadian rhythms (Morgenthaler et al., 2007). The lack of limb movement is measured as sleep time (Morgenthaler et al., 2007). Due to patients underestimating sleep time by sleep diaries, the Actigraph wrist device can be used to measure sleep time alone or in conjunction with the sleep diary (Vallieres & Morin, 2003).

Pittsburgh Sleep Quality Index (PSQI). The PSQI includes self-rated items to measure sleep quality and has been widely used in sleep research (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). With the appropriate permission, the questionnaire was adapted to night shift workers where questions were reworded for daytime sleep. The PSQI looks at seven components of sleep quality which include: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleep medication, and daytime dysfunction (Buysse et al., 1989). The sum of all components provides the measure for overall sleep quality. Scores > 5 indicate poorer sleep quality. The questionnaire was given before and after project implementation for comparison.

Cost/Benefit Analysis

The prevalence of significant sleep disturbance and daytime sleepiness has been estimated to be around 30% of night shift workers (Drake, Roehrs, Richardson, Walsh, & Roth 2004). The Epworth Sleepiness Scale is another means for screening for symptoms of shift work disorder. For individuals scoring high on the Epworth Sleepiness Scale, there has been an 11% increase in healthcare utilization (Kapur et al., 2002b). The national projected health cost utilization per employee for 2014 was $11,176 (Society for Human Resource Management, 2013). There are currently 130 insured night shift workers at the project facility. If deemed beneficial, the initiation of a sleep hygiene program could potentially result in an annual decrease of $1,229.36 health cost for each of the predicted 30% night shift workers suffering from excessive daytime sleepiness. This would be equivalent to a $47,945.04 predicted savings annually.

- 130 insured night shift employees x 30% predicted to have significant sleep problems = 39 employees.
- Estimated $11,176 annual healthcare utilization costs per employee x 11% increase in healthcare utilization cost related to excessive sleepiness = $1,229.36.
- 39 estimated employees x $1,229.36 = $47,945.04 total predicted cost savings.

These cost savings from initiating a sleep hygiene program for night shift workers are most likely underestimated. Preventing sleepiness/fatigue related accidents could result in much more substantial savings. Also, there appears to be a large turnover of night shift employees. Improving daytime sleep may have an added benefit of improved

job satisfaction and reduced burnout resulting in cost savings from reduced night shift employee turnover. Table 7 provides a detail of the costs in evaluating a sleep hygiene project.

Table 7

Estimated Costs of Interventions

Actigraph Wrist Devices & Computer Download	$3,130
Light Devices and Blue-light Blocking Sunglasses	$1,140
Pittsburgh Sleep Quality Questionnaire	$0
Developed Screening Questionnaire	$0
Melatonin	$60
2mm Garbage Bags (Blackout Window Devices)	$120
Supplies / Staff Time	$100
Total	$4550

Note: Cost of sleep program would be less due to being able to reuse Actigraph Devices.

Ethical Considerations

At the July, 2015 night shift employee meeting, agency hired temporary night shift workers were allowed to be screened for daytime sleep problems through the presented questionnaire but could not participate in actual study due to not being eligible to visit the employee clinic. Their information was used for data collection purposes only. If deemed beneficial, the sleep hygiene program could extend to temporary employees with the approval of the human resource department and hiring agency. Another possible issue was that many employees did not put their name on the questionnaire, so if sleep issues were identified there was not a way to contact the employee for any follow up. If the sleep hygiene program was deemed beneficial, policy would be implemented to continually screen all night shift employees for sleep difficulties through their annual wellness visit at the employee clinic.

Project Implementation

After IRB approval, the sleep hygiene project began. Evidence-based sleep interventions were evaluated in the startup of a night shift sleep hygiene program. Interventions included the following.

- Sleep time shifting (going to bed as soon as possible after leaving night shift).
- Blue-light blocking sunglasses on the way home after night shift.
- Melatonin 3mg prior to daytime sleep.
- Home environmental changes (darkening room, earplugs, turning off electronics, etc.)

Night shift employees were screened for participation in the sleep program by the questionnaire administered at employee meeting in July, 2015. Those qualified for the project and who agreed to participate were set up for baseline actigraphy measurements using Actigraph wrist device and sleep quality measurements using the Pittsburgh Sleep Quality Index (PSQI) sleep quality questionnaire. Sleep logs and Actigraph measurements were to be taken for two weeks for baseline information and appropriateness for participation in project. Due to malfunction of Actigraph equipment, baseline information continued to include the use of the PSQI for total sleep quality and total sleep time baseline information used the "duration of sleep" section of PSQI to estimate sleep time.

Process of Project

Participants were contacted in person and screened for eligibility for project and also screened for associated risk with each intervention. A dose of 3mg of melatonin would be utilized prior to daytime sleep. Light therapy, using portable Litebook Edge device (10,000 lux), would be utilized when awakening from day or night time sleep and during night shift when needed if feeling sleepy. To reduce participant risk, the following tables show eligibility requirements for over-the-counter melatonin and light therapy. (Table 8 and 9)

Table 8

Criteria for use of Melatonin

Melatonin was not used for the following:
1. Anyone on hypertensive medication.
2. Anyone on diabetes medication.
3. Anyone being on depressive medication.
4. Anyone on anxiety medication.
5. Anyone having a history of severe anxiety.
6. Anyone having a history of depression.
7. Women trying to get pregnant or considering getting pregnant.
8. Anyone younger than age 20.
9. Anyone with a history of glaucoma.
10. Anyone with a history of seizure disorder.
11. Anyone with a history of liver impairment.
12. Anyone using anticoagulants.
13. Anyone showing a drug-to-drug interaction with current medications and melatonin.

Note. If employee answered "no" to all questions, considered eligible for melatonin 3mg.

Table 9

Criteria for use of Light Therapy

Light Therapy was not used for the following:
1. Anyone having a previous history of eye disease.
2. Anyone having a previous history of macular degeneration.
3. Anyone having previous laser corrective surgery.
4. Anyone having a previous diagnosis of seasonal affective disorder.
5. Anyone having a previous diagnosis of depression.
6. Anyone having a previous diagnosis of bipolar disorder.
7. Anyone that is overly sensitive to light.
8. Anyone who suffers from migraines.
9. Anyone who has a history of diabetes.
10. Anyone who is currently taking antibiotics.

Note: If employee answered "no" to all questions, considered eligible for light therapy.

In October and November 2015, a total of nine Actigraph devices were downloaded for evaluation and demonstrated poor sleep patterns and decreased sleep time for those wearing Actigraph device. After the first nine employees were evaluated, the Actigraph program malfunctioned. Attempts were made to download the Actigraph software again and employees were asked to repeat time wearing Actigraph devices. Again, information was lost due to unforeseen malfunction of software. Due to time constraints of project and inconvenience of employees, it was deemed necessary to move forward with the sleep project using self-reported sleep as measured by "Duration of Sleep" on PSQI before and after the sleep hygiene project interventions for comparison. The PSQI questionnaire would continue to be utilized to measure overall sleep quality before and after sleep hygiene project for comparison. Twenty-six potential participants were identified. Some individuals did not choose to participate, one individual demonstrated symptoms of sleep apnea and was not eligible, two individuals reported sleeping 6-7 hours and were considered not eligible and one individual scored a "5" (good sleep quality) on baseline PSQI and was not eligible. One employee had an original score of "7" but was on prescribed sleep medicine and PSQI was recalculated to "4" as per directions of PSQI. This employee was then not eligible for sleep hygiene project. Table 10 will show the results of the baseline information.

Table 10

Baseline Results

Gender & Year(s) on Night Shift	8 or 12 hour worker	Baseline Pittsburgh Sleep Quality Index Questionnaire (> 5 = poor sleep & "reported daytime sleep")		Other information
1. Female 3 years	8 hour	Score 7	"5-6 hours"	
2. Male 1 year	8 hour	Score 5	"6 ½ hours"	Not eligible due to good sleep quality
3. Male 3 years	8 hour			No longer employed
4. Male 0 years	8 hour	Score 10	"4 hours"	College during the day everyday. Declined.
5. Male	12 hour	Score 12	"4-5 hours"	Signs of sleep apnea. Not eligible.
6. Male	8 hour	Score 11	"4-5 hours"	Online college during the day along with childcare duties.
7. Male 3 years	12 hour	Score 8	"6 hours"	Picks up son from school some days.
8. Female	12 hour	Score 9	"5 hours"	Keeps grandchild during the day.
9. Female 0 years	12 hour	Score 11	"4-6 hours"	College during the day 1 day per week.
10. Female 0 years	12 hour	Score 6	"6 hours"	
11. Male 4 years	12 hour	Score 11	"4 hours"	Child care every other week.
12. Male 4 years	12 hour	Score 14	"6 hours"	Picks up child from school some days.
13. Female 0 years	12 hour	Score 13	"6-7 hours"	Second job during the day some days. Not eligible due to reported sleep time.
14. Female 3 years	12 hour	Score 12 hours"	"4 ½ -5	
15. Male	8 hour			Sleeping better –Declined.
16. Male 4 years	8 hour	Score 11	"4-5 hours"	
17. Male 2 years	12 hour	Score 7	"5 hours"	
18. Male	12 hour	Score 7	"4-6 hours"	Online college during the day and childcare duties. Declined.
19. Male 3 years	12 hour	Score 11	"4 hours"	Has since moved to Day Shift.

20.	Female 1 year	12 hour	Score 9	"6-7 hours"	Not eligible due to reported sleep time.
21.	Male 2 years	12 hour			Sleeping better - Declined.
22.	Male	12 hour			Declined.
23.	Male 1 year	12 hour	Score 10	"2-5 hours"	
24.	Female 3 years	12 hour	Score 4	"6 hours"	Not eligible due to recalculated PSQI
25.	Male	12 hour	Score 9	"6 hours"	
26.	Male 4 years	12 hour	Score 9	"6 hours"	

Note. Years of employment information was obtained from human resource records from 2014.

Sleep Hygiene Participants. Eligible participants were randomized for the project. Some participants in the sleep hygiene project were not eligible for all interventions. Participants were given a description of the project and directions on use of each intervention. The following directions were given to each participant.

- Participant was advised to put on blue-light blocking sunglasses on their way home from night shift until getting into bed.
- Participant was advised to take melatonin 3mg prior to daytime sleep.
- Participant was encouraged to have a home environment conducive to sleep (darkening room, wearing ear plugs, turning off electronics, etc.).
- Participant was advised to use Light Therapy (10,000 lux) device for 15-30 minutes upon arising from nighttime or daytime sleep. Light Therapy use of 15-30 minutes was also encouraged when participant was feeling sleepy during night shift work. Light Therapy was approved for use during break times.
- Participant was encouraged to go straight home from work and to try to get to bed as soon as possible so to prevent light exposure allowing the body to wake up.

A packet was given to each participant showing the previous steps. The packet also included information on how to properly use each intervention and when to stop an intervention if there was a problem. The final eleven participants were enrolled in the sleep hygiene project.

Results

After 3-4 weeks of sleep hygiene program interventions, the participants again filled out the PQSI questionnaire for comparison including the subjective sleep time. Sleep logs were collected to check for compliance of sleep time shifting and to verify reported sleep time. The following figures will describe the findings. (Tables 11-21)

Table 11

Participant 1

Interventions used: 1. Blue-light Blocking Sunglasses 2. Light Therapy 3. Melatonin 3mg 4. Sleep Schedule Change	Pre-test (before interventions) 0 = better sleep 3 = worse sleep	Post-test 0 = better sleep 3 = worse sleep
Duration of Sleep	2	1
Sleep Disturbance	1	2
Sleep Latency	1	2
Day Dysfunction Due to Sleepiness	2	1
Sleep Efficiency	0	0
Overall Sleep Quality	1	1
Total Pittsburgh Sleep Quality Index (PSQI) Normal is ≤ 5	Total = 7	Total = 7

Note. Participant 1 used all interventions.

Participant 1 felt she overall slept better. For all interventions, she felt the melatonin 3mg worked the best. She did not feel like the Light Therapy helped but admits that she did not use it at work. She only felt sleepy late in the shift and did not want the light to wake her up prior to morning sleep. She also felt the glasses helped. Overall she felt that it did not take her as long to get to sleep and felt her sleep was sounder. She plans on using the glasses and melatonin in the future. (Table 11)

Table 12

Participant 2

Interventions used: 1. Blue-light Blocking Sunglasses 2. Light Therapy 3. Melatonin 3mg 4. Sleep Schedule Change	Pre-test (before interventions) 0 = better sleep 3 = worse sleep	Post-test 0 = better sleep 3 = worse sleep
Duration of Sleep	3	2
Sleep Disturbance	2	1
Sleep Latency	2	1
Day Dysfunction Due to Sleepiness	2	1
Sleep Efficiency	0	0
Overall Sleep Quality	2	2
Total Pittsburgh Sleep Quality Index (PSQI) Normal is ≤ 5	Total = 11	Total = 7

Note. Participant 2 used all interventions.

Participant 2 felt like his sleep did improve overall. He feels that most of his problems come from current lifestyle. He takes online college classes during the day while providing childcare services for his son. If he was not working on school work, he would run errands with his son. He would put the glasses on at 11 am and would go to bed at 4 pm. He took melatonin 3mg around 4 pm. His wife would get home from work around 4 pm and he would go to sleep. Melatonin seemed to make him drossy at times. He felt like sleep would have improved more if he could have done program correctly. He did use light therapy at work and felt like it helped him wake up. He plans on using therapies in the future. (Table 12)

Table 13

Participant 3

Interventions used: 1. Blue-light Blocking Sunglasses 2. Light Therapy 3. Melatonin 3mg 4. Sleep Schedule Change	Pre-test (before interventions) 0 = better sleep 3 = worse sleep	Post-test 0 = better sleep 3 = worse sleep
Duration of Sleep	1	0
Sleep Disturbance	2	1
Sleep Latency	2	2
Day Dysfunction Due to Sleepiness	1	1
Sleep Efficiency	0	0
Overall Sleep Quality	2	0
Total Pittsburgh Sleep Quality Index (PSQI) Normal is ≤ 5	Total = 8	Total = 4

Note. Participant 3 used all interventions.

Participant 3 did feel like his sleep improved overall. The melatonin 3mg and glasses helped the most. "I didn't realize how much blue-light affected me". He felt like he could fall asleep much quicker. He put on glasses if he had to get up from daytime sleep. "Glasses helped me fall back asleep". He admits that he did not use light at work because of lack of privacy. He did use light therapy at home but is not sure it helped. (Table 13)

Table 14

Participant 4

Interventions used: 1. Blue-light Blocking Sunglasses 2. Light Therapy 3. Sleep Schedule Change	Pre-test (before interventions) 0 = better sleep 3 = worse sleep	Post-test 0 = better sleep 3 = worse sleep
Duration of Sleep	2	3
Sleep Disturbance	2	2
Sleep Latency	1	0
Day Dysfunction Due to Sleepiness	2	2
Sleep Efficiency	0	1
Overall Sleep Quality	1	1
Need Medication to Sleep	1	1
Total Pittsburgh Sleep Quality Index (PSQI) Normal is ≤ 5	Total = 9	Total = 10

Note. Participant 4 used all interventions except Melatonin 3mg.

Participant 4 overall felt like her sleep improved. She fell asleep faster and slept more continuously compared to waking up frequently prior to sleep program. The glasses helped her the most. She felt like light therapy did not help and therefore did not use at work. She admits that her schedule affected her sleep. She would pick up her grandchild from school. Most days she would not go to sleep until 12 noon after working nights. (Table 14)

Table 15

Participant 5

Interventions used: 1. Blue-light Blocking Sunglasses 2. Light Therapy 3. Melatonin 3mg 4. Sleep Schedule Change	Pre-test (before interventions) 0 = better sleep 3 = worse sleep	Post-test 0 = better sleep 3 = worse sleep
Duration of Sleep	2	3
Sleep Disturbance	2	1
Sleep Latency	3	3
Day Dysfunction Due to Sleepiness	2	2
Sleep Efficiency	1	3
Overall Sleep Quality	1	2
Total Pittsburgh Sleep Quality Index (PSQI) Normal is ≤ 5	Total = 11	Total = 14

Note. Participant 5 used all interventions.

Participant 5 felt like her overall sleep was the same. She admits that light therapy helped her wake up after sleep but chose not to use light therapy at work because she felt she did not need it. She stated that melatonin may have helped her go to sleep faster. She felt the glasses did not make a difference. She felt like light therapy would help employees wake up who were sleepy. She also felt that melatonin would help employees get to sleep faster. (Table 15)

Table 16

Participant 6

Interventions used: 1. Blue-light Blocking Sunglasses 2. Light Therapy 3. Melatonin 3mg 4. Sleep Schedule Change	Pre-test (before interventions) 0 = better sleep 3 = worse sleep	Post-test 0 = better sleep 3 = worse sleep
Duration of Sleep	1	0
Sleep Disturbance	1	1
Sleep Latency	2	1
Day Dysfunction Due to Sleepiness	2	1
Sleep Efficiency	0	0
Overall Sleep Quality	1	1
Total Pittsburgh Sleep Quality Index (PSQI) Normal is ≤ 5	Total = 7	Total = 4

Note. Participant 6 used all interventions.

Participant 6 felt her sleep improved overall. She was sleeping longer instead of small increments. "When I go to sleep, I don't toss and turn". She admits that melatonin 3mg made her drowsy at first. She did not want to take melatonin every day because of drowsiness. Her plan is to take every other day when working, she may also consider breaking dose in half. She was not sure if glasses helped or not. Light therapy she thought was very beneficial. She would use it during her break time and also felt it helped her wake up after sleep. She plans on using melatonin and light therapy in the future. (Table 16)

Table 17

Participant 7

Interventions used: 1. Blue-light Blocking Sunglasses 2. Sleep Schedule Change	Pre-test (before interventions) 0 = better sleep 3 = worse sleep	Post-test 0 = better sleep 3 = worse sleep
Duration of Sleep	1	0
Sleep Disturbance	2	1
Sleep Latency	2	2
Day Dysfunction Due to Sleepiness	1	1
Sleep Efficiency	0	0
Overall Sleep Quality	2	0
Total Pittsburgh Sleep Quality Index (PSQI) Normal is ≤ 5	Total = 9	Total = 3

Note. Participant 7used all interventions except Melatonin 3mg and Light Therapy.

Participant 7 felt like his sleep improved overall. The glasses helped with his sleep "some". He admits that biggest difference was with getting to bed sooner. As per the program, he would go to bed as soon as he got home. Before sleep project his bed time was 10 am. Now he is going to bed around 8:30 am. He would wear glasses from work until going to bed. He does feel like glasses would help other night shift employees with their sleep. (Table 17)

Table 18

Participant 8

Interventions used: 1. Blue-light Blocking Sunglasses 2. Light Therapy 3. Melatonin 3mg 4. Sleep Schedule Change	Pre-test (before interventions) 0 = better sleep 3 = worse sleep	Post-test 0 = better sleep 3 = worse sleep
Duration of Sleep	1	2
Sleep Disturbance	2	2
Sleep Latency	3	3
Day Dysfunction Due to Sleepiness	2	2
Sleep Efficiency	1	2
Overall Sleep Quality	2	2
Total Pittsburgh Sleep Quality Index (PSQI) Normal is ≤ 5	Total = 11	Total = 13

Note. Participant 8 used all interventions.

Participant 8 felt his sleep improved some. Admits that he had trouble switching from night sleep to day sleep. On nights off, he would go to bed at 10 pm and wake up at 12 am and then go back to sleep at 6 am. On nights off, he would need to get up at 1:45 pm to get his daughter from school. Melatonin helped him get to sleep but admits that he could not stay asleep. He admits that glasses helped. He states that he used light therapy 25% of the time when awakening from sleep. He did not use light therapy more often because he felt like it was not working. Light therapy at work was not used in the break room because he felt he had a lack of privacy. He states that he plans on using glasses and melatonin in the future and would consider using light therapy more at home. (Table 18)

Table 19

Participant 9

Interventions used: 1. Blue-light Blocking Sunglasses 2. Light Therapy 3. Sleep Schedule Change	Pre-test (before interventions) 0 = better sleep 3 = worse sleep	Post-test 0 = better sleep 3 = worse sleep
Duration of Sleep	3	3
Sleep Disturbance	2	2
Sleep Latency	3	3
Day Dysfunction Due to Sleepiness	1	3
Sleep Efficiency	0	1
Overall Sleep Quality	2	2
Total Pittsburgh Sleep Quality Index (PSQI) Normal is ≤ 5	Total = 11	Total = 14

Note. Participant 9 used all interventions except Melatonin 3mg.

Participant 9 felt like his overall sleep did not change. He states that light therapy gave him headaches and glasses caused him to have blurred vision. He stopped using both devices after several days. Participant felt that he may need prescription glasses and was not sure if blue-light blocking glasses contributed to blurred vision entirely. He was planning on making an appointment to see his eye doctor for evaluation. He verbalized that he was very frustrated with his lack of sleep and has even considered changing jobs. (Table 19)

Table 20

Participant 10

Interventions used: 1. Blue-light Blocking Sunglasses 2. Light Therapy 3. Melatonin 3mg 4. Sleep Schedule Change	Pre-test (before interventions) 0 = better sleep 3 = worse sleep	Post-test 0 = better sleep 3 = worse sleep
Duration of Sleep	3	3
Sleep Disturbance	2	2
Sleep Latency	3	2
Day Dysfunction Due to Sleepiness	2	3
Sleep Efficiency	1	0
Overall Sleep Quality	3	2
Total Pittsburgh Sleep Quality Index (PSQI) Normal is ≤ 5	Total = 14	Total = 12

Note. Participant 10 used all interventions.

Participant 10 was not sure if his sleep improved overall. He states that he recently obtained several puppies which were kept in his bathroom which is beside his bedroom. He feels this hampered his sleep because of the noise the puppies made. He felt that glasses and melatonin helped the most. He did use the light therapy at home when he awoke from sleep but could not tell a difference in how he felt. He did not use light therapy at work. He is planning on using melatonin and glasses in the future and also felt these interventions would help others on night shift. (Table 20)

Table 21

Participant 11

Interventions used: 1. Blue-light Blocking Sunglasses 2. Light Therapy 3. Melatonin 3mg 4. Sleep Schedule Change	Pre-test (before interventions) 0 = better sleep 3 = worse sleep	Post-test 0 = better sleep 3 = worse sleep
Duration of Sleep	1	1
Sleep Disturbance	2	1
Sleep Latency	2	1
Day Dysfunction Due to Sleepiness	2	1
Sleep Efficiency	0	0
Overall Sleep Quality	2	1
Total Pittsburgh Sleep Quality Index (PSQI) Normal is ≤ 5	Total = 9	Total = 5

Note. Participant 11 used all intervention.

Participant 11 felt his overall sleep improved "at times". He felt that melatonin allowed him to sleep better. He felt the glasses were very beneficial. Light therapy was only used at home. Because he could not tell a difference, he did not use light therapy at work. He plans on using glasses and melatonin in the future. He was not planning on using light therapy in the future. (Table 21)

Table 22

Overall Results of All Participants.

	Pre-test (before interventions) 0 = better sleep 3 = worse sleep	Post-test 0 = better sleep 3 = worse sleep
Duration of Sleep	2	1.7
Sleep Disturbance	1.7	1.45
Sleep Latency	2.18	1.63
Day Dysfunction Due to Sleepiness	1.72	1.54
Sleep Efficiency	0.36	0.64
Overall Sleep Quality	1.64	1.36
Total Pittsburgh Sleep Quality Index (PSQI) Normal is ≤ 5	Total = 9.6	Total = 8.32

Note. Overall results improved but not to a good sleep quality of ≤ 5 total PSQI.

Overall results of all 11 participants showed that total sleep quality did improve (9.6 to 8.32), but participants as a whole did not improve to "good sleep quality" at ≤ 5 total PSQI. Overall, there was an improvement in all categories of sleep except for sleep efficiency (0.36 pretest and 0.64 post-test). (Table 22)

Table 23

Total All Participants with Baseline PSQI ≥ 10

	Pre-test (before interventions) 0 = better sleep 3 = worse sleep	Post-test 0 = better sleep 3 = worse sleep
Duration of Sleep	2.4	2.6
Sleep Disturbance	2	1.6
Sleep Latency	2.8	2.4
Day Dysfunction Due to Sleepiness	1.8	2.2
Sleep Efficiency	0.6	1.2
Overall Sleep Quality	2	2
Total Pittsburgh Sleep Quality Index (PSQI) Normal is ≤ 5	Total = 11.6	Total = 12

Note. Overall results for participants with baseline PSQI ≥ 10.

For the five participants who's baseline PSQI was ≥10, the group as a whole did not improve demonstrated by a total PSQI of 11.6 at baseline to a 12 post interventions. However, sleep disturbance and sleep latency did demonstrate some improvement. (Table 23)

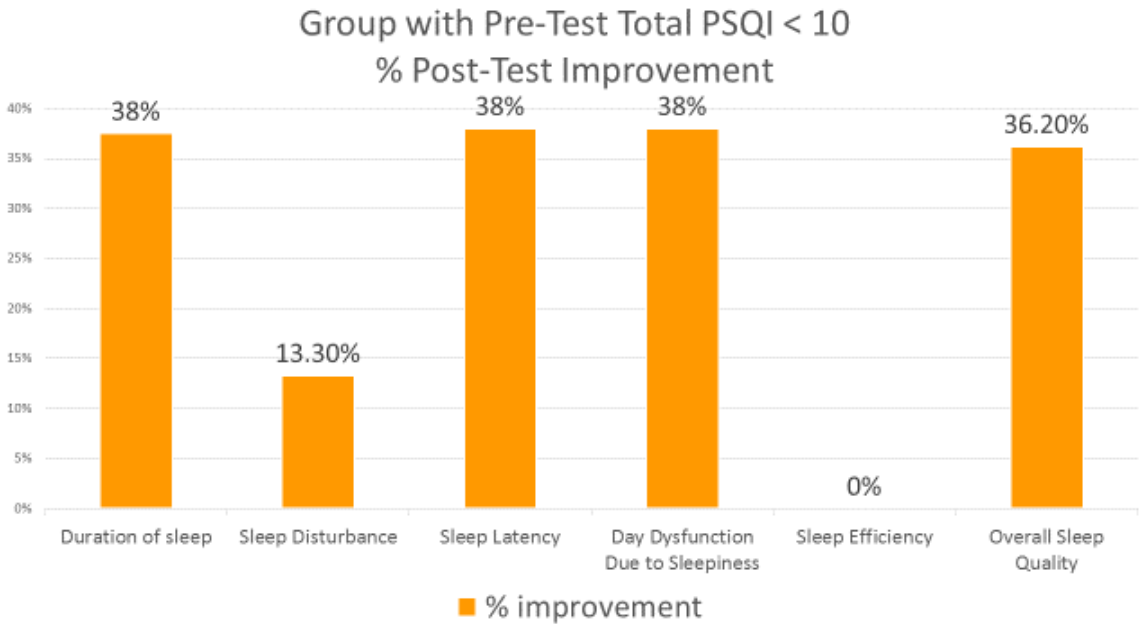
For the six participants who's baseline total PSQI was < 10, the group as whole did not improve to "good sleep quality" as measured by a total PSQI of ≤ 5. Improvement in total PSQI was demonstrated by a decrease from 8 at baseline to 5.32 after sleep hygiene project interventions. There was a noted improvement in all sleep categories except in sleep efficiency where the scored remained "0.16". See Figure 4 and Table 24.

Table 24

All Participants with Baseline PSQI < 10

	Pre-test (before interventions) 0 = better sleep 3 = worse sleep	Post-test 0 = better sleep 3 = worse sleep
Duration of Sleep	1.67	1
Sleep Disturbance	1.5	1.33
Sleep Latency	1.67	1
Day Dysfunction Due to Sleepiness	1.67	1
Sleep Efficiency	0.16	0.16
Overall Sleep Quality	1.33	0.83
Total Pittsburgh Sleep Quality Index (PSQI) Normal is ≤ 5	Total = 8	Total = 5.32

Note. Overall results for participants with baseline PSQI < 10.



Note. All sleep categories improved except for Sleep Efficiency which remained "0.16" on post-test.

Figure 4. Group with Pre-Test Total PSQI < 10% Post-Test Improvement.

Total reported sleep time improved in this group by an average of 55 minutes per day. Although sleep time did not improve to the appropriate 7 hours, there was an improvement in sleep from an average of 5.4 hours to 6.3 hours after sleep hygiene program interventions. See Table 25.

Table 25

Average Sleep Time Improvement in Group with Baseline PSQI < 10

	Pre-Test Day Sleep Reported	Post-Test Day Sleep Reported	Total
Participant #1	5-6 hours (5.5 avg.)	6 hours	(+) 30 min/ day
Participant #2	6 hours	7-8 hours (7.5 avg.)	(+) 90 min/ day
Participant #3	5 hours	4-5 hours (4.5 avg.)	(-) 30 min/ day
Participant #4	6 hours	7 hours	(+) 60 min/ day
Participant #5	4 hours	5-8 hours (6.5 avg.)	(+) 150 min/ day
Participant #6	6 hours	6-7 hours (6.5 avg.)	(+) 30 min/ day
Average Totals	5.4 hours	6.3 hours	(+) 55 min/ per day

Note: Average reported sleep time improved in all but one individual in group with baseline score of < 10.

Project Evaluation

Comparison to Literature

According to the American Academy of Sleep Medicine, the sleep interventions used in this sleep hygiene project are nonprescription therapies for individuals demonstrating symptoms of shift work disorder. Actigraphy and sleep logs are guidelines for identifying shift work sleep difficulties. Timed light therapy and timed melatonin administration are guidelines in assisting shift workers with daytime sleep (Morgenthaler et al., 2007). Some studies have demonstrated swings in circadian rhythms using light therapy (Morgenthaler et al., 2007). In research, bright light exposure (10,000 lux) during the night shift and restricting light exposure by wearing sunglasses in the morning demonstrated improvement in alertness during the night shift and better daytime sleep compared to using bright light alone (Yoon, Jeong, Kwon, Kang, & Song, 2002). Blue-light blocking sunglasses without light therapy also seems to improve daytime sleep for night shift workers (Sasseville et al., 2009). Melatonin has shown to benefit shift workers with daytime sleep to improve sleep duration and sleep quality compared to placebo (Morgenthaler et al., 2007). The night shift sleep hygiene program startup project showed similar findings with the above mentioned interventions for a group of participants who scored < 10 on baseline total sleep quality PSQI measurement. As a group, all categories of sleep improved except for sleep efficiency which remained "0.16". For individuals with significantly poor sleep quality (≥ 10 total PSQI), the sleep hygiene project interventions did show measureable improvements in some categories but not others. Similarly, some participants demonstrating significantly

poor sleep quality (≥ 10 total PSQI) showed measureable improvements in total sleep quality but not to a "good sleep quality" amount of ≤ 5.

Theoretical Framework

The Neuman's Systems Model was an appropriate conceptual model to guide this project. Secondary prevention was the goal. By starting a sleep hygiene program using evidence based strategies, sleep time measured by "duration of sleep" and sleep quality measured by "total PSQI" improved in the group of participants whose baseline total PSQI was < 10. Decreased sleep time and poor sleep quality among night shift workers appears to be common and are considered internal environmental stressors. By improving sleep time and sleep quality, the employee's physiological and psychological core variables are further protected by strengthening the night shift worker's normal lines of defense and normal lines of resistance. Improving sleep through primary prevention has the potential to reduce future risks of poor health and also the potential to reduce future night shift accidents.

Interpretation of Process

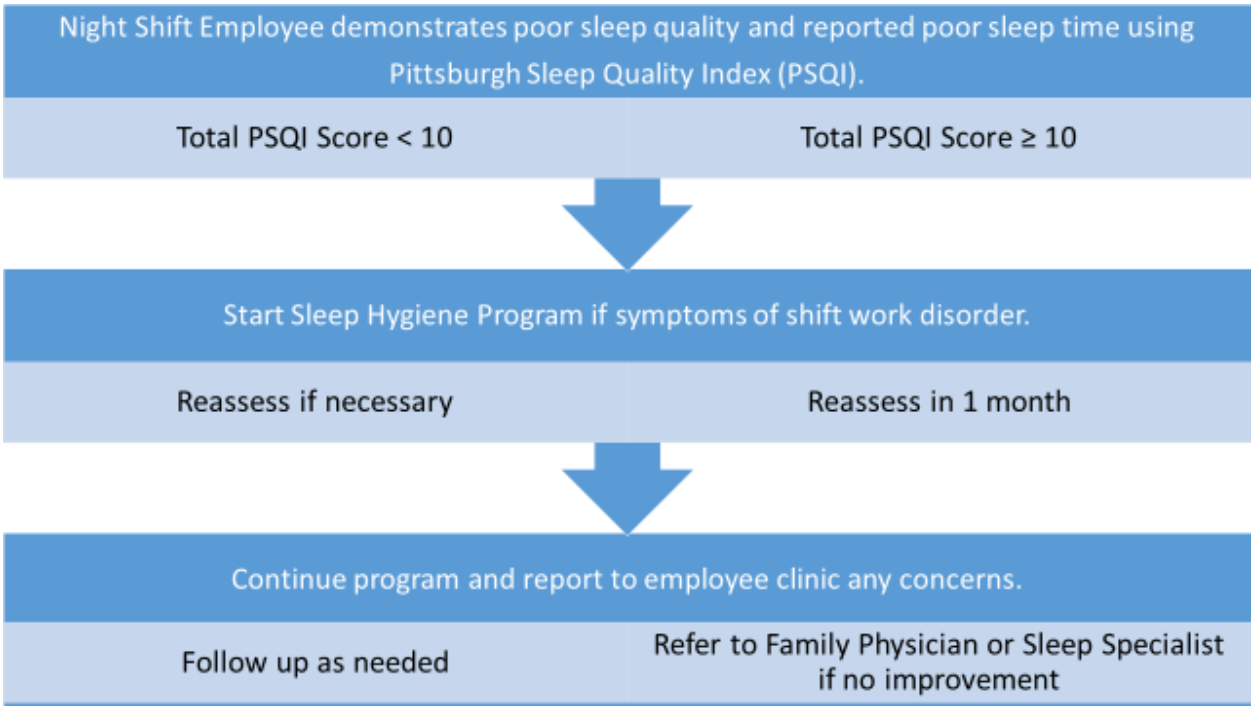
Achievements. The sleep hygiene project was deemed to be a success. The Pittsburgh Sleep Quality Index (PSQI) assists the clinician with identifying poor sleep quality and decreased sleep time ("duration of sleep") in night shift workers. The PSQI will be implemented in the near future as a screening instrument to assess sleep quality and reported sleep time. The sleep hygiene program interventions used in this project will be utilized as treatment options for individuals demonstrating symptoms of shift work disorder. The Litebook Edge device (light therapy) will be provided to employees to be utilized on a trial basis. If the Litebook Edge device is deemed beneficial, insurance

approval will be sought or the employee can self-pay for the device. Education will be provided on home environmental changes to promote restorative daytime sleep (ex. darkening room, ear plugs, reducing noise, turning off electronics, etc.). Melatonin will be suggested which the employee can purchase at the local pharmacy for a minimal cost. The benefits of blue-light blocking sunglasses will be discussed with the human resource department. These devices may be provided at no cost to night shift employees who demonstrate symptoms of shift work disorder. Finally, education will be provided to night shift employees on the priority of adequate sleep as a part of their overall health.

Recommendations for improvements. In discussing the various sleep hygiene interventions with participants, both the blue-light blocking sunglasses and the melatonin 3mg most often were felt to be beneficial. Overall, the light therapy devices were not used at work because the participants either felt it was not helping or the lack of privacy in the breakroom. A possible solution would be to have the devices available to all individuals in the breakroom by signing the devices in and out. An educational in-service would need to be provided on how to use devices and who should not use devices. Another option might be to brighten the breakrooms by replacing the current lighting with blue-light light bulbs. In walking through the manufacturing facilities, many of the older buildings were found to be poorly lit. Many of the light bulbs were burnt out and needed replacing. This poor lighting may contribute to sleepiness and accidents. Replacing lighting with blue-light or at a minimum replacing burnt out lighting may contribute to employee alertness at night.

Plan for sustainability. At the manufacturing facility, insured employees are required to see the Nurse Practitioner at the employee clinic once per year for a wellness

visit. This may include screening lab work, health coaching, and health goal setting. Screening for poor sleep quality and reported poor sleep time will now be included in the annual screening assessment. For night shift workers, the sleep hygiene program would be implemented when appropriate. Employees whose total PSQI is ≥ 10 will proceed with the sleep hygiene program and will be retested for improvement after three to four weeks of utilizing interventions. If sleep continues to be poor, a referral to their primary doctor or to a sleep specialist would be appropriate. See Figure 5 below.



Note. Plan for sleep hygiene program sustainability is to screen annually at employee clinic wellness visit or when deemed appropriate.

Figure 5. Pittsburgh Sleep Quality Index (PSQI)

Conclusion

As previously stated, almost one-fifth of all employees work night shift. Shifts can be eight hours, 10 hours, 12 hours and/or rotating (day and night). Working night shift affects the body's normal circadian sleep system. These alterations can lead to a decreased sleep time and a poor sleep quality for night shift workers. Studies have demonstrated that this chronic loss of sleep can negatively influence the body's immune, cardiovascular, and endocrine systems. Lack of sleep has also been linked to mental health problems. This project is a small representation of how prevalent shift work disorder symptoms are in the night shift population. With a nationwide movement towards disease prevention and wellness, proper sleep should be at the forefront. Although chronic diseases, such as cancer, hypertension, obesity, and diabetes, receive much attention in secondary prevention, restorative sleep can help boost the body's immune system and provides the body vitality to exercise. If an individual is not getting enough restorative sleep, they may lack the energy to exercise or the motivation to improve on healthy lifestyle habits. Night shift workers are especially susceptible to inadequate sleep. The night shift sleep hygiene program implemented in this project is a simple nonprescriptive way to improve sleep quality and sleep time. By improving sleep, night shift workers will not only feel better but also be healthier. For employers, there is the potential for reduced health claims and reduced work accidents. Also, employers may see an improvement in employee job satisfaction resulting in better night shift retention along with the potential for increased night shift productivity.

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